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ABSTRACT

This paper describes Clarion University of Pennsylvania's TACCOL (Technology Advancing a Continuous Community of Learners) program. TACCOL develops and implements an innovative environment for interfacing technology with mathematics and science education while achieving and maintaining systemic change in teacher education and K-12 learning. TACCOL's goal is to provide professional development for higher education faculty, prospective teachers, and cooperating teachers from local school districts to enhance instruction in mathematics and science through the use of computers, graphing calculators, calculator-based rangers, calculator based-laboratories, and multiple probes. A variety of professional development activities have been used to enable participants to acquire minimum competencies. Participants learn through hands-on, interactive activities, with a constructivist approach to teaching and learning. TACCOL will be sustained through continued university and school professional development opportunities, curricular change, and the ongoing integration of technology into mathematics and science content classes. Since university faculty have been trained to use the technology, they are integrating technology use into general education and methods courses for prospective teachers. Prospective teachers are feeling confident about integrating technology into their future classrooms. Practicing teachers who participated in summer workshops are prepared to integrate technology into their classrooms. (SM)

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Technology Advancing a Continuous Community of Learners (TACCOL)

Integrating Technology into Teacher Preparation

AACTE

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Making a Difference in the Learning of All Students

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TECHNOLOGY ADVANCING A CONTINUOUS COMMUNITY OF LEARNERS (TACCOL)

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Integrating Technology into Teacher Preparation

Introduction

Link-to-Learn is Pennsylvania's three-year, $132 million initiative to expand the use of technology in the classroom, including new and upgraded computers for schools and technology training for teachers. Link-to-Learn was approved by the General Assembly in Act 107 in 1996. In the first two years, Link-to-Learn distributed $83.6 million for computers, professional development, and local and regional investments in infrastructure. In year 3, Link-to-Learn invested an additional $48.3 million in K-12 and higher education initiatives.

Link-to-Learn is a state response to a national call for reform in mathematics and science education. The National Research Council's *National Science Education Standards* provide suggestions for reforms in science instructional practices. The National Council of Teachers of Mathematics have contributed three national documents for suggested changes in mathematics instruction [*The Curriculum and Evaluation Standards for School Mathematics* (1989), *The Professional Standards for Teaching Mathematics* (1991), and *The Assessment Standards for School Mathematics* (1995)]. Unfortunately, some teachers are unable to implement the suggestions for reform instruction due to insufficient support from their school districts and colleagues in their attempt to make changes in their instructional techniques (Carbone, 1998). One solution to this problem is well-designed professional development programs that provide teachers with the knowledge and support needed for implementing innovations in teaching and learning mathematics and science (Carbone, 1998; Harry, 1996). Link-to-Learn funds projects to provide professional development opportunities for university faculty, practicing teachers, and prospective teachers.

Link-to-Learn Higher Education Initiative

In February of 1999, twenty colleges and universities in Pennsylvania were awarded funding from the Link-to-Learn Higher Education Initiative, *Integrating Technology into Teacher Preparation (ITTP).* This initiative specifically targeted the improvement of technology integration skills of Pennsylvania's prospective teachers. The grants emphasized teaching with technology rather than teaching about technology. The projects funded were organized to ensure current and future teachers the ability to use technology to teach rigorous academic subjects in meaningful ways. The ITTP funding complements Pennsylvania's recently adopted academic standards. The standards outline what students should know and be able to do at the conclusion of grades three, five, eight and 11.

With the encouragement and support of Dr. Gail Grejda, Dean of the College of Education and Humans Services, Dr. Elaine Carbone, Mathematics Department, and Dr. Vickie Harry, Education Department, wrote a proposal on behalf of Clarion University. The Clarion project, *Technology Advancing A Continuous Community of Learners (TACCOL),* was funded in the amount of $330,500 matched by $125,000 from Clarion University.

Technology Advancing a Continuous Community of Learners (TACCOL)

TACCOL develops and implements an innovative environment for interfacing technology with mathematics and science education while achieving and maintaining systemic change in teacher education and K - 12 learning. The goal of the project is to provide professional development for higher education faculty, prospective teachers, and practicing teachers (cooperating teachers from area school districts) to enhance instruction in mathematics and science through the use of computers, graphing calculators, calculator based rangers (CBRs), calculator based laboratories (CBLs), and multiple probes .

TACCOL funds have purchased 64 laptop computers, 31 zip drives, 18 super drives, three Proxima projectors, 200 graphing calculators (TI-73s, TI-89s, and TI-83+s), eight viewscreens for the calculators, 28 CBRs, 16 CBLs, four sets of 16 different probes, client licenses for Office 98 and AppleWorks 5.0, hubs (for Internet access), ethernet cords, TI - GRAPH LINKs,

Graphical Analysis software, and four portable storage carts. Each storage cart locks for security purposes and includes a power strip into which the laptops are plugged when not in use. The entire cart is then plugged into an outlet. This system allows the computers' batteries to recharge when not in use. Each computer battery holds its charge for about three hours (more than enough time for classroom use). In addition, each cart is stocked with viewscreens, CBLs, CBRs, zip and super drives, ethernet cords, and hubs. The portable carts can be transported into any classroom and facilitate the implementation of technology-based instruction including Internet access for all laptops.

Technology Competencies

As a result of this initiative, by the fall semester in the year 2000, participating university faculty, practicing teachers, and prospective teachers achieved the following minimum technology competencies:

- use word processing, spreadsheet, and database software and the appropriate hardware as tools for enhancing personal productivity and for teaching mathematics and science content.
- develop instruction using word processing, spreadsheet, and database software to increase student productivity and student content knowledge in mathematics and science.
- explore the Internet using www browsers to enhance instruction.
- create interactive instructional modules using PowerPoint.
- use telecommunications systems to receive and send e-mail messages, create listservs, and utilize the Internet as an instructional resource.
- integrate Calculator Based Rangers (CBRs), Calculator Based Laboratories (CBLs), probes, TI-89 calculators, and TI-73 calculators into mathematics and science instruction.

The competencies were developed collaboratively with the Education Department in the College of Education and Human Services, the Mathematics and Physics Departments in the College of Arts and Sciences, and basic education administration and faculty to improve content and pedagogical knowledge of university faculty, practicing teachers, and prospective teachers in the teaching and learning of science, mathematics, and technology.

Components for Implementation of Technology Instruction

To enable the university faculty, practicing teachers, and prospective teachers to acquire these competencies, Clarion University implemented the following professional development activities:

- incorporated a technology component (15 additional hours) to supplement the elementary and secondary mathematics and science methods courses during the fall 1999 semester.
- provided professional development opportunities for university faculty to learn the technology competencies. These opportunities enabled university instructors to integrate and model technology competencies in the teaching of mathematics and science in the content and methods courses for elementary and secondary education majors during the fall 1999 semester.
- provided professional development opportunities for practicing teachers who serve as cooperating teachers for Clarion University student teachers. These workshop were held during July 1999 and two follow-up sessions were held during the fall 1999 semester. These opportunities enabled teachers to integrate and model technology competencies in K - 12 classrooms which serve as sites for student teacher placements.

Through the infusion of technology in the mathematics and science curricula, a constructivist approach to teaching and learning was presented to university faculty, prospective, and practicing teachers through their attendance and participation in Link-to-Learn workshops at Clarion University. Through hands-on, activity based learning, educators in the Departments of Education, Mathematics, Physics, Biology, and Chemistry modeled a technological approach to the teaching and learning of science and mathematics.

The technology competencies support the effective teaching of the Pennsylvania Academic Standards for Mathematics and the emerging Academic Standards for Science and Technology for grades K-12. Additionally, these competencies support science, technology, and mathematics constructivist teaching practices for primary, intermediate, middle school, and/or secondary teachers. To address these Pennsylvania Academic Standards, hands-on data gathering experiences were developed to be modeled by university faculty for preservice and inservice

teachers. Further expansion of the basic usage of the technology in the mathematics and science classrooms will continue to enhance pedagogical practices as well as mathematical and scientific content knowledge.

During the funding period, this project directly serves approximately 55 prospective teachers, approximately 30 higher education faculty, and 110 cooperating teachers. Clarion University partnered with the following twelve school districts: Brockway Area, Brookville Area, Clarion Area, Clarion Limestone Area, Cranberry Area, Franklin Area, Keystone, North Clarion County, Oil City Area, Redbank Valley, Union, and Valley Grove to strengthen the relationship between the student teachers and the cooperating teachers in their attempts to infuse technology in the K - 12 classrooms.

A Continuous Community of Learners

The TACCOL project at Clarion will be sustained through continued university and school faculty professional development opportunities, curricular change, and the ongoing integration of technology into mathematics and science content classes. Since the university faculty who teach the mathematics and science content and methods courses have been trained to use the technology purchased by the grant, they are integrating the use of technology into general education and methods courses for prospective teachers as well as serving as models of exemplary instructional strategies. The prospective teachers are beginning to feel confident about integrating technology into mathematics and science classroom practices as a result of the technology component of their mathematics and science methods courses. The integration of technology was then infused into the curriculum of the methods courses that were offered during the spring semester for all mathematics and science secondary majors and for all elementary majors. The practicing teachers who participated in the summer workshops also are prepared to integrate technology into classroom practice as evidenced by the projects they conducted in their classrooms. Their presentations at the final follow-up session also exhibited evidence of student learning. During the spring 2000 semester, student teachers are matched with the cooperating teachers who participated in the summer workshops. They are presently working together to implement technology competencies

into classroom practice. All future prospective teachers will use and learn to integrate technology competencies into their teaching after participating in the university's classes where the faculty continue to integrate technology in their instructional practices.

Additional institutional changes needed to sustain the project after the funding ends include curricular changes and ongoing support for retraining of new faculty. Course syllabi will be rewritten to include the technology competencies as requirements for teacher certification and then sent forward for approval by the Committee on Courses and Programs of Study (CCPS). The Advancing the Development of Educators in Pennsylvania through Technology Training (ADEPTT) Center at Clarion University will continue ongoing technology training for new faculty. Workshops will be offered for faculty to learn to use the technology purchased by the Link-to-Learn project on a regularly scheduled basis through the ADEPTT Center.

The university faculty, the practicing teachers and the prospective teachers comprise the continuous community of learners in the implementation of technology in their classrooms. The university faculty taught both the practicing and the prospective teachers; the practicing teachers are working in collaboration with the prospective teachers during their student teaching experience. The project directors collaborate with the cooperating teachers in supervising the student teachers. The growth of the continuous community of learners will strengthen the technologically-enhanced instruction augmented by the Pennsylvania Academic Standards for Mathematics and the emerging Pennsylvania Academic Standards for Science and Technology.

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